National Aeronautics and Space Administration

NASA's Airborne Science Program Supporting Earth Observing Satellites

International Symposium on Remote Sensing of the Environment

Sydney, Australia

April 11, 2011

2011 ISRSE

Outline

April 11, 2011

- **Presenter**
  - **Randy Albertson, Airborne Science Program Deputy Director**
- **Co-Authors:**
  - **Dr. Steve Volz and Bruce Tagg, NASA HQ's**
  - **Matthew Fladeland, NASA ARC**
  - **Dr. Susan Schoenung, Longitude 122 West**
- **Program Objectives and Capabilities**
- **NASA's Earth Observing Satellites**
- **How Airborne Science is Supporting NASA's EOS**
- **Closing**

Program Objectives

Satellite Calibration and Validation

Provide platforms to enable essential calibration measurements for the Earth observing satellites, and the validation of data retrieval algorithms.

Support New Sensor Development

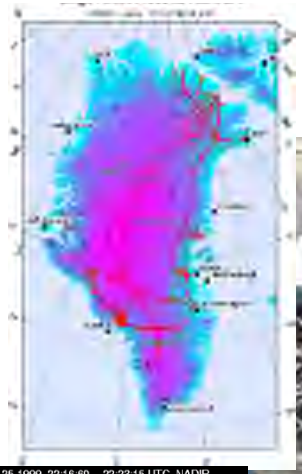
Provide atmospheric flight opportunities to test and refine new instrument technologies/algorithms, and reduce risk prior to committing sensors for launch into space.

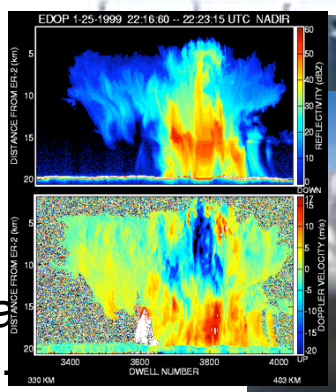
Process Studies

Obtain high-resolution temporal and spatial measurements of complex local processes, which can be coupled to global satellite observations for a better understanding of the complete Earth system.

Development of Next-Generation Scientists and Engineers

Foster the development of our future workforce with the hands-on involvement of graduate students, and young scientists/engineers in all aspects of ongoing Earth science investigations.





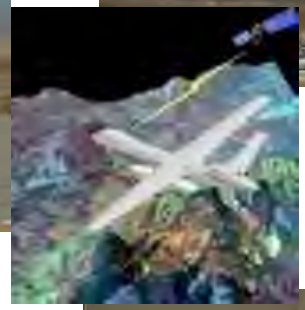
Airborne Science Program Operations

Core Airborne Systems:
ER-2, WB-57, DC-8, P-3, G-III





New Technology Airborne Systems
Global Hawk, Airborne Networks

Catalog Airborne Systems (Utilized)
Ikhana, B-200, S-3, Aerosonde, SIERRA, Learjet, Twin Otter, Caravan etc





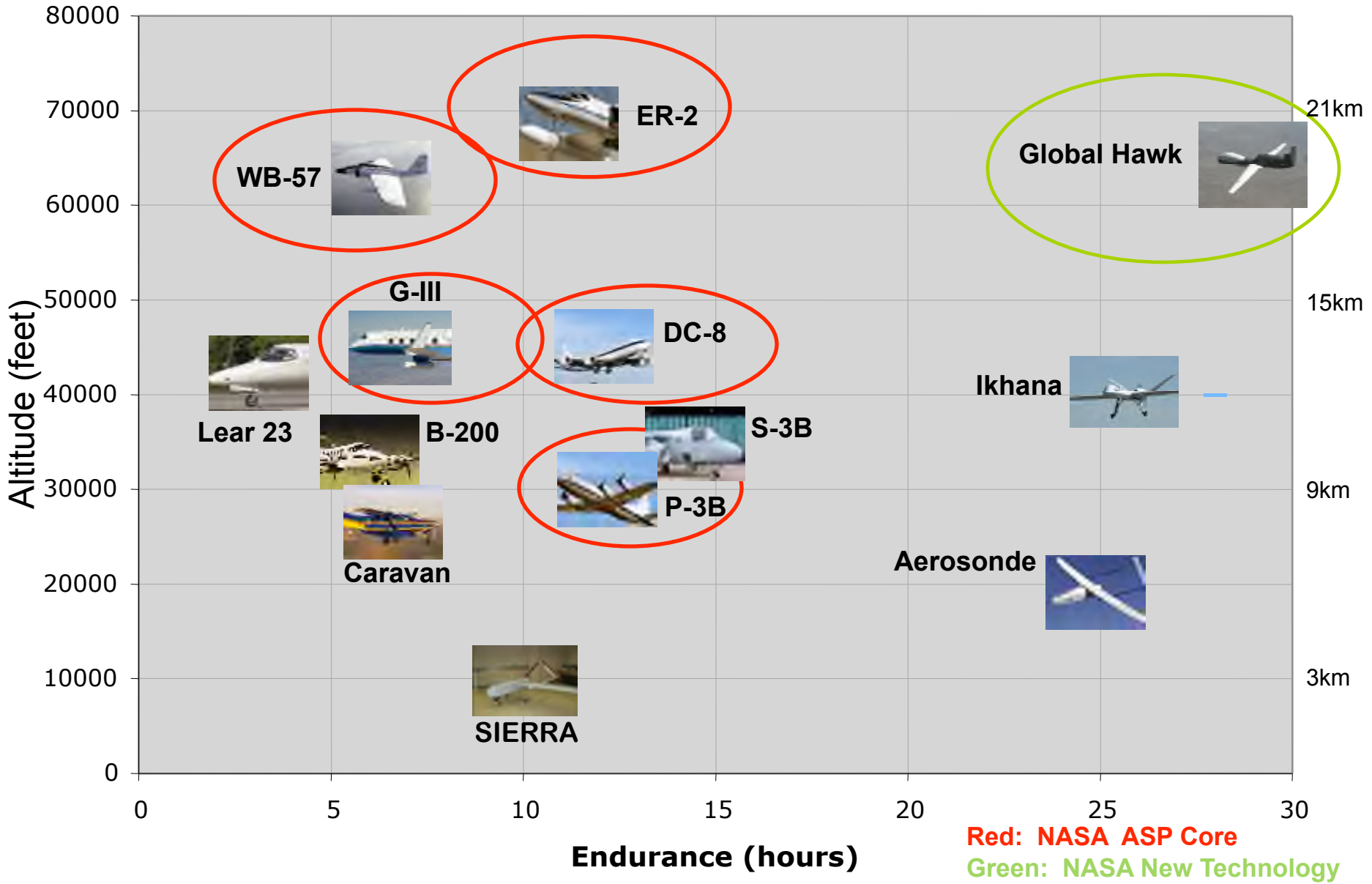
Airborne Sensor Facility, Mission/Campaign Management

Represent all NASA Science Mission Directorate Aviation Assets, including SOFIA, to the Agency

Over 50 aircraft available to the Program

http://airbornescience.nasa.gov/platforms/platforms.html

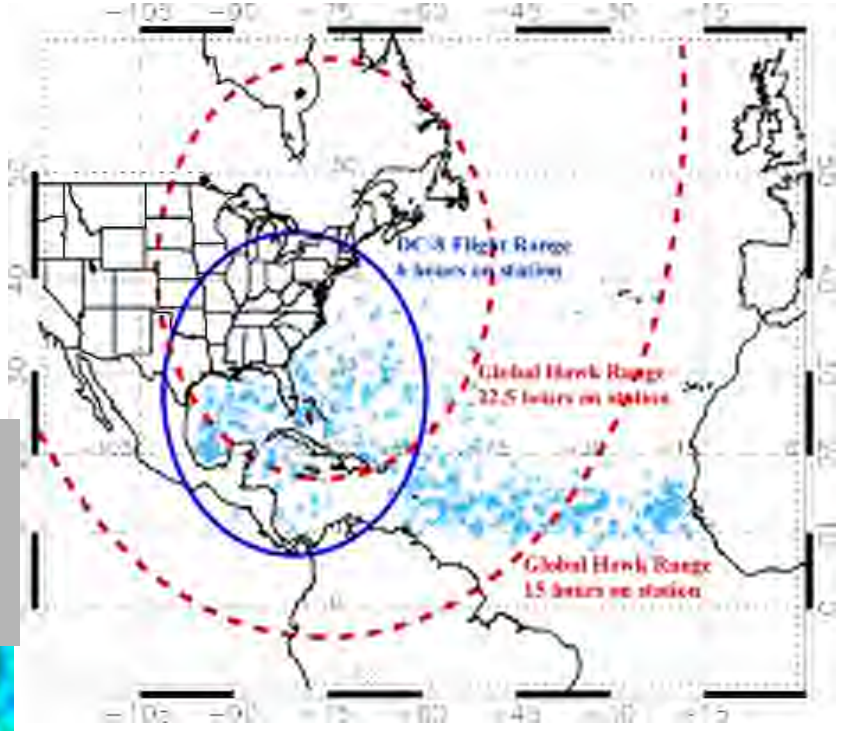
NASA Unique Airborne Science Aircraft



Where are we now?

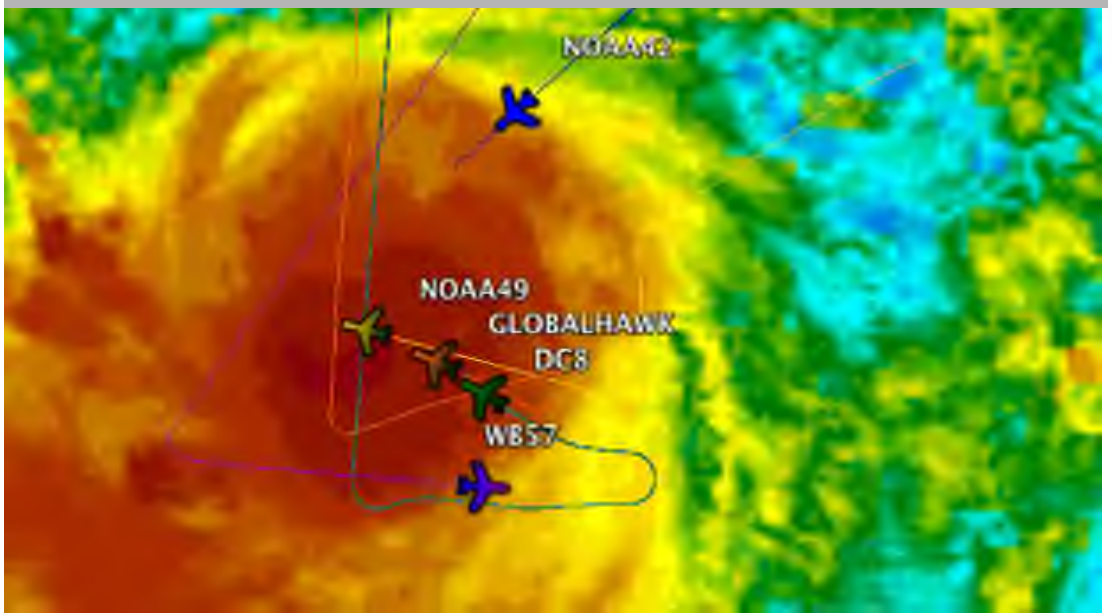
Genesis and Rapid Intensification Processes

The GRIP experiment was a NASA Earth science field experiment in 2010 that was conducted to better understand how tropical storms form and develop into major hurricanes. The experiment was done in collaboration with NOAA and USAF operational hurricane missions.

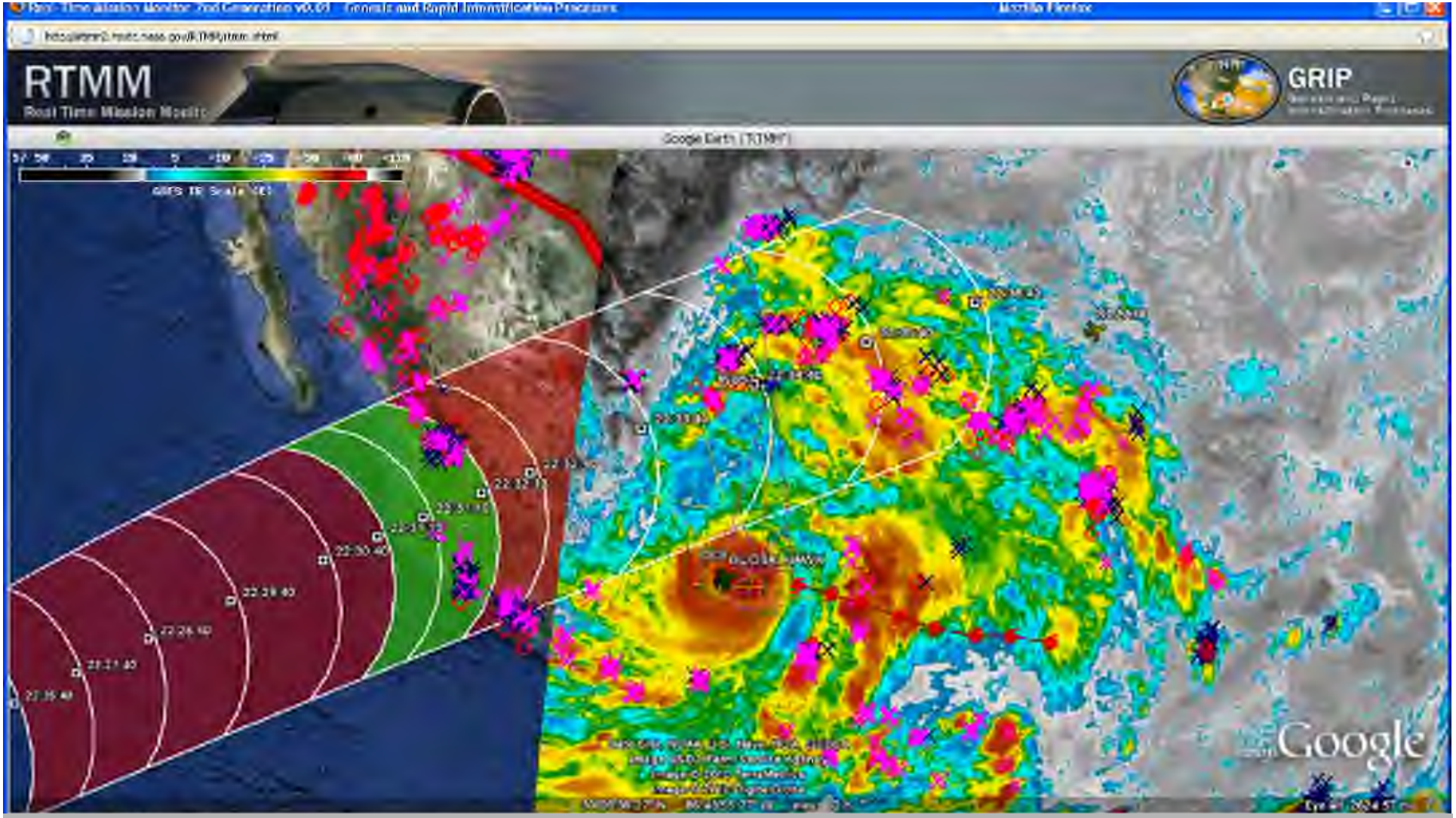


NASA is using the DC-8 aircraft, the WB-57 aircraft, and the Global Hawk Unmanned Airborne System (UAS) configured with a suite of *in situ* and remote sensing instruments that are observing and characterizing the lifecycle of hurricanes.
(http://grip.nsstc.nasa.gov/index.html)

Screen capture of Real Time Mission Monitor showing the NOAA 49 & NASA Global Hawk, DC8, & WB57 making a coordinated pass over Hurricane Karl eye. A NOAA P3 (NOAA 42) & USAF C130 were also sampling the storm at this time.

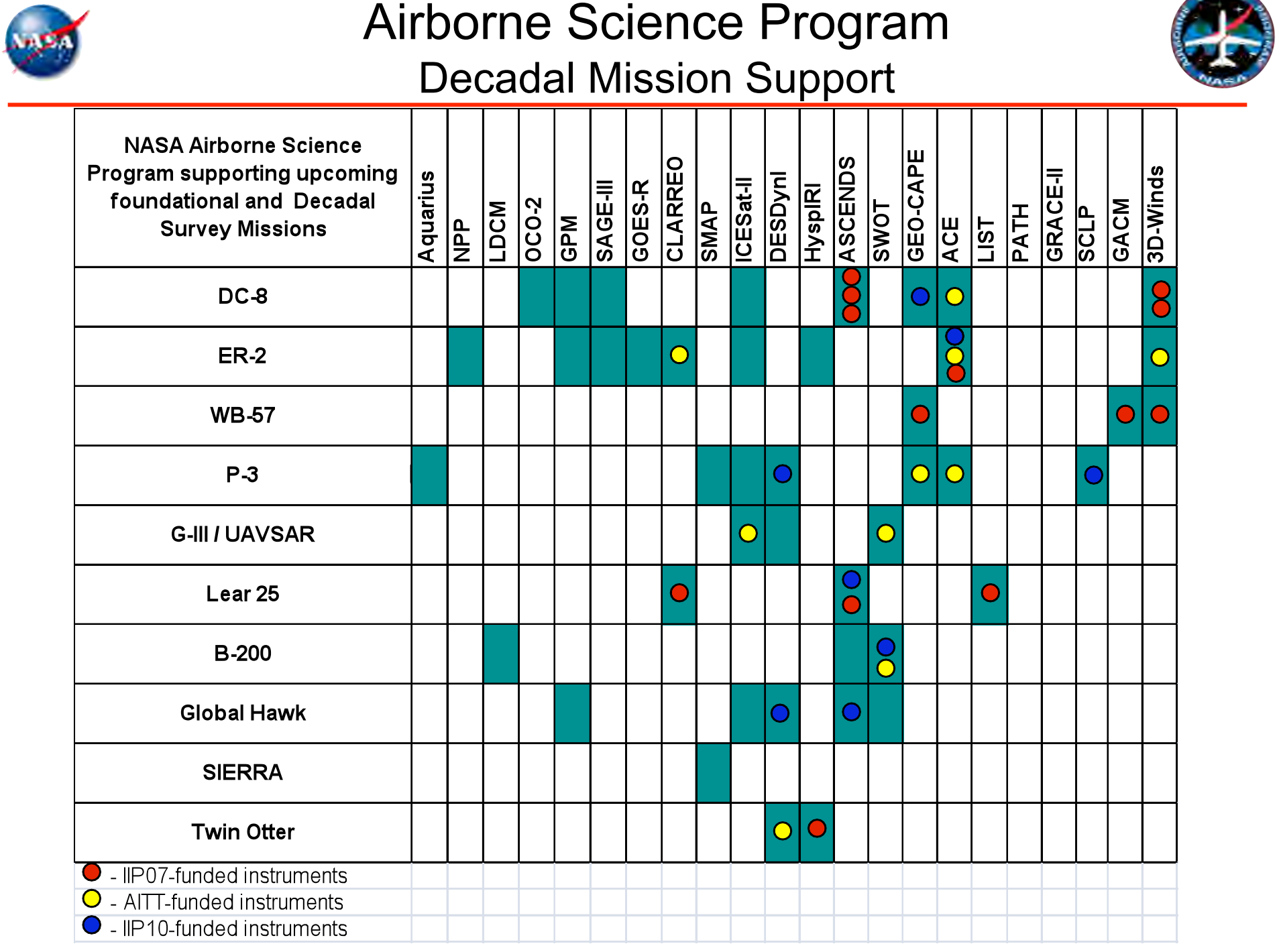


GRIP and TRMM Satellite



A coordinated pass over the eye of hurricane Karl with the NASA Global Hawk and DC8, with a narrow miss by the TRMM satellite

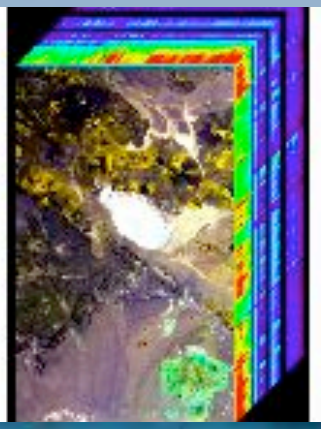
Airborne Science Program
Decadal Mission Support



Decadal Survey Mission Support

DESDynI - Deformation, Ecosystem Structure and Dynamics of ICE: UAVSAR flights to Alaska and western US volcanic areas, New England forests, and California faults.

ASCENDS - Active Sensing of CO2 Emissions over Nights, Days, & Seasons: Coordinated Airborne Experiments to Measure CO2 column densities. Three instrument systems on three aircraft in Oklahoma and concurrently on the DC-8 in conjunction with SARP.



HyspIRI - Hyperspectral Infrared Imager: Airborne Visible Infrared Imaging Spectrometer (AVIRIS) and MASTER instruments on ER-2.

SMAP - Soil Moisture Active Passive: PALS flights on P-3 (late FY08 / early FY09).

SWOT - Surface Water and Ocean Topography: Preliminary measurements with Ka-band SAR (GLISTN) to and from Greenland.

ICESat-2 - SIMPL: Pathfinder technology test flights on Lear 25 and MABEL upcoming on ER-2.

3-D Winds - TWiLiTE: Pathfinder technology test flights.

ACE – High Spectral Resolution Lidar and Research Scanning Polarimeter

Instrument Tests

Slope Imaging Multi-polarization Photon-counting Lidar (SIMPL)*

PI: D. Harding

Pathfinder for ICESat-2 technology

SIMPL transmitter and receiver

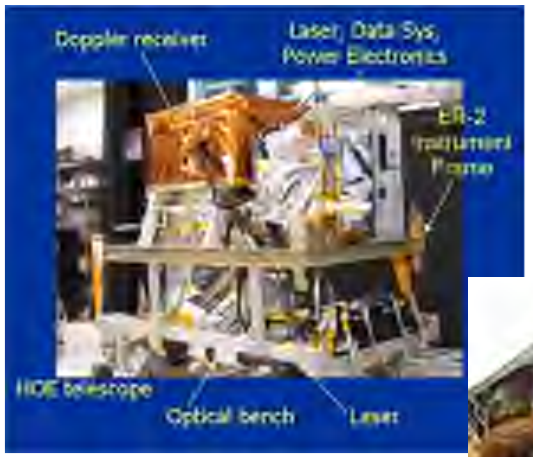
Flight test goal and accomplishment:
3 test flights, 8 hours on GRC Lear 25 over Lake Erie and snow-covered landscape

*ESTO support

Tropospheric Wind Lidar Technology Experiment (TWiLiTE)*

PI: B. Gentry

Flight test goal and accomplishment:
25 hours of test data, flying on the ER-2 from EAFB



Pathfinder for 3-D Winds technology

TWiLiTE components and installed in Q-Bay

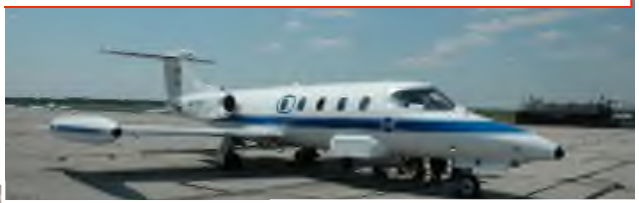
*ESTO support

Coordinated Airborne Experiments to Measure CO2 column densities in support of ASCENDS Mission Definition

LaRC/ITT Acclaim lidar instrument in NASA UC-12

- LaRC & ITT instr. team, LaRC aircraft
- Ed Browell/LaRC, Team Leader
- Instrument development via ITT, Earth Science AITT funding

GSFC Airborne CO2 lidar instrument in NASA Lear-25



- GSFC team, NASA Glenn aircraft
- Jim Abshire/GSFC, Team Leader
- Instrument development via ESTO ACT & IIP programs, GSFC IRAD

JPL Airborne CO2 lidar instrument in Twin Otter

- JPL team, Twin Otter aircraft
- Gary Spiers/JPL, Team Leader
- Instrument development via Coherent Techn., ESTO ACT program, JPL IRAD

- Objective: Measure & compare CO2 column densities over calibration sites with developmental lidar candidates for the ASCENDS mission
- Approach: Simultaneous CO2 measurement flights at different altitudes over well calibrated areas:
  - DOE SGP ARM site (Lamont, OK): 7/28 - 8/4/09
  - North Carolina & Eastern Shore VA 8/17/09
- Collaborate with DOE/LBL & Caltech researchers for in-situ & ground-based FTS measurements

Student Airborne Research Program (SARP 2011)

SARP 2011 Research Topics

Evapotranspiration of almond orchards and vineyards, Central Valley
Dr. Susan Ustin, UC Davis

Air quality effects of commercial dairy operations and urban air pollution, Central Valley, CA & Los Angeles
Dr. Don Blake, UC Irvine

Kelp growth and biomass, Santa Barbara Channel & Monterey Bay
Dr. Raphael Kudela, UC Santa Cruz

85 Applications for admission, 30 admitted

Student Profile: **14 Female/16 Male**

Average GPA: **3.62**

Academic Disciplines:

Earth & Environmental Science	30%
Biology, Chemistry & Physics	44%
Meteorology & Atmospheric Science	13%
Engineering & Mathematics	13%

DC-8 will be used for two 6-hour data flights

Instruments to be employed are:

MASTER for remote sensing of kelp and agricultural processes

Whole Air Sampler (WAS) for in situ gas sampling

Digital Mapping System (DMS) for multi-angle imaging

29 Universities in 21 states (in blue above)

6 week program: **6/19/2011-7/29/2011**

The program concludes with the students presenting their research results in formal presentations

In addition, the top 3 student presentations will be given at the NASA booth during the 2011 Fall AGU meeting in San Francisco

All of the lectures and student presentations will be videotaped and available on the internet

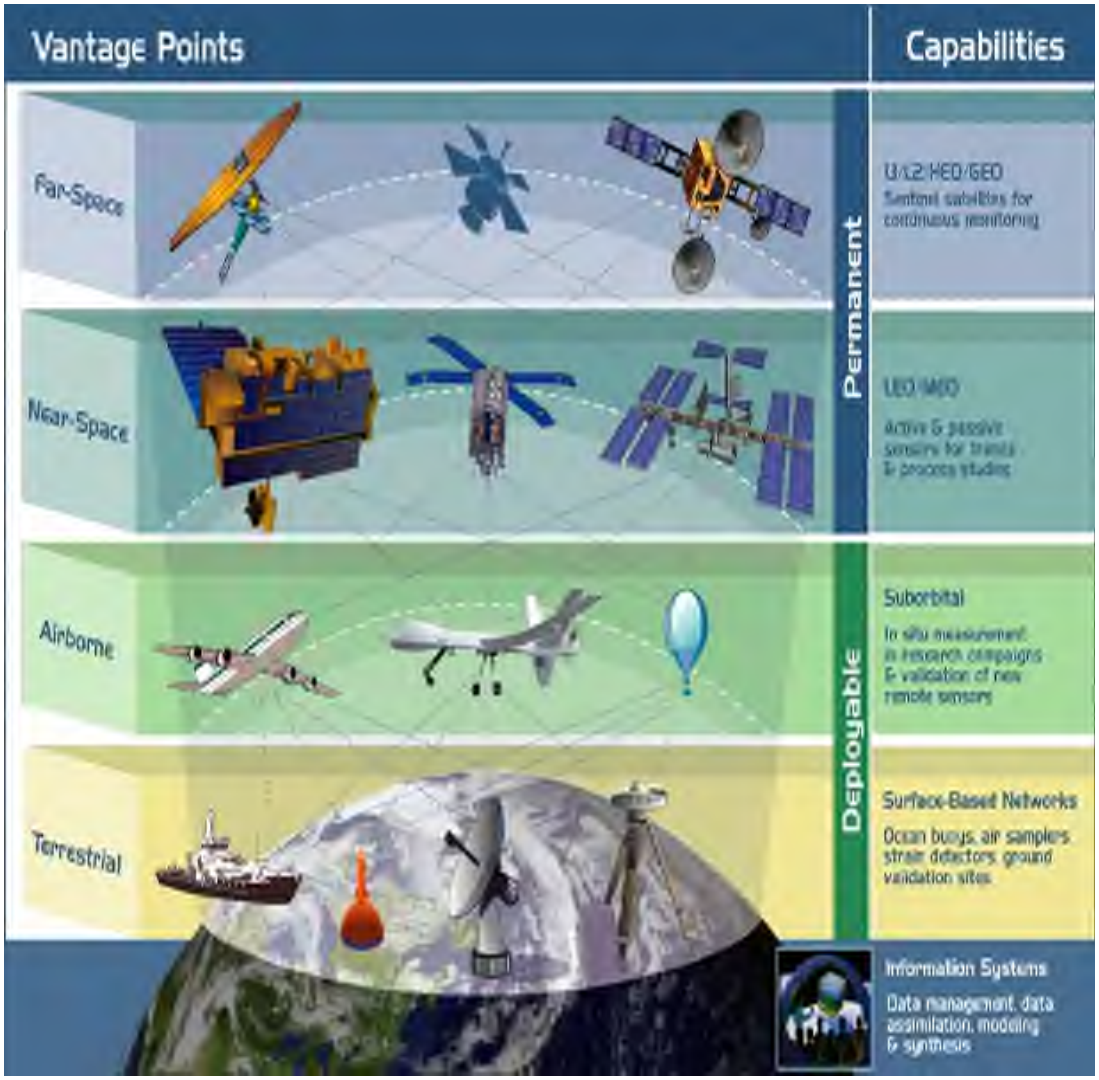
SARP 2011 on Facebook: facebook.com/nserc.sarp2011

SARP 2011 on Twitter: twitter.com/sarp2011

NSERC
National Suborbital Education and Research Center
UND THE UNIVERSITY OF NORTH DAKOTA

For more information please visit http://www.nserc.und.edu/learning/SARP2011.html

Airborne and Ground-Based Measurement Programs



- Airborne science assets actively engaged in mission definition and development activities
- Process studies with satellite calibration/validation imbedded
- Instrument /algorithm development flights supporting mission definition (DESDynI and ASCENDS)
- Data gathering as gap fillers (ICESat - ICESat-2)
- Test beds for IIP and AITT missions
- Calibration/Validation after launch
- Earth Venture class missions
- Students hands-on experience

Closing

- **Airborne Science Program Objectives:**
  - Satellite Calibration and Validation
  - Support New Sensor Development
  - Process Studies
  - Development of Next-Generation Scientists and Engineers

- **Program Capabilities**
  - Aircraft: Core, New Technology, and Catalog
  - Sensors and Science Support Systems
  - Mission/Campaign Science Project Support

- **Program Leadership**
  - Bruce Tagg, Director, bruce.a.tagg@nasa.gov
  - Randy Albertson, Deputy Director, randal.t.albertson@nasa.gov
  - Website: http://airbornescience.nasa.gov/